



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

July 3, 2013

Mr. Michael J. Pacilio  
President and Chief Nuclear Officer  
Exelon Generation Company, LLC  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3 - REQUEST  
FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT  
REQUEST FOR EXTENDED POWER UPRATE (TAC NOS. ME9631 AND  
ME9632)

Dear Mr. Pacilio:

By letter dated September 28, 2012, as supplemented by letters dated February 15, 2013, May 7, 2013, May 24, 2013, June 4, 2013, and June 27, 2013, (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML122860201, ML13051A032, ML13129A143, ML13149A145, ML13156A368, and ML13182A025, respectively), Exelon Generation Company, LLC (Exelon, the licensee) submitted a license amendment request for Peach Bottom Atomic Power Station, Units 2 and 3. The proposed amendment would authorize an increase in the maximum power level from 3514 megawatts thermal (MWt) to 3951 MWt. The requested change, referred to as an extended power uprate, represents an increase of approximately 12.4 percent above the current licensed thermal power level.

The Nuclear Regulatory Commission's (NRC) staff is reviewing your submittal and has determined that additional information is needed to complete its review. The specific questions are found in the enclosed request for additional information (RAI). The RAI questions were provided in draft form to Mr. Kevin Borton of your staff via e-mails on May 14, 2013, and July 2, 2013. The draft questions were sent to ensure that the questions were understandable, the regulatory basis for the questions was clear, and to determine if the information was previously docketed.

A conference call between the NRC staff and the Exelon staff was held on May 23, 2013, to discuss the questions. On July 2, 2013, Mr. Borton stated that Exelon would provide a response to the RAI questions within 30 days of the date of this letter.

Please note that if you do not respond to this letter by the agreed-upon date or provide an acceptable alternate date in writing, we may reject your application for amendment under the provisions of Title 10 of the *Code of Federal Regulations*, Section 2.108.

M. Pacilio

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If you have any questions, please contact me at (301) 415-1420.

Sincerely,

A handwritten signature in black ink, appearing to read 'RBE', with a long horizontal flourish extending to the right.

Richard B. Ennis, Senior Project Manager  
Plant Licensing Branch I-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-277 and 50-278

Enclosure:  
Request for Additional Information

cc w/encl: Distribution via ListServ

REQUEST FOR ADDITIONAL INFORMATION  
REGARDING PROPOSED LICENSE AMENDMENT  
EXTENDED POWER UPRATE  
EXELON GENERATION COMPANY, LLC  
PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3  
DOCKET NOS. 50-277 AND 50-278

By letter dated September 28, 2012, as supplemented by letters dated February 15, 2013, May 7, 2013, May 24, 2013, June 4, 2013, and June 27, 2013, (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML122860201, ML13051A032, ML13129A143, ML13149A145, ML13156A368, and ML13182A025, respectively), Exelon Generation Company, LLC (Exelon, the licensee) submitted a license amendment request for Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. The proposed amendment would authorize an increase in the maximum power level from 3514 megawatts thermal (MWt) to 3951 MWt. The requested change, referred to as an extended power uprate (EPU), represents an increase of approximately 12.4 percent above the current licensed thermal power level.

The Nuclear Regulatory Commission (NRC) staff is reviewing your submittal and has determined that additional information is needed to complete its review. The specific request for additional information (RAI) is addressed below.

**Nuclear Performance and Code Review Branch (SNPB)**

Reviewers: Mathew Panicker and Andrew Proffitt

**SNPB-RAI-1**

Please provide responses to the questions listed below regarding the type(s) of fuel used in the PBAPS, Units 2 and 3, cores during the previous and current cycles of operation.

- a. Section 2.8.1 of the Power Uprate Safety Analysis Report (PUSAR<sup>1</sup>) indicates that both PBAPS units "plan" to transition to GNF2 fuel. Do the current cores in PBAPS, Units 2 and 3, have mixed cores? If so, specify the types of fuel in the mixed core.
- b. Specify when the two units transitioned to use of GE-Hitachi Nuclear Energy (GEH) GNF2 fuel.
- c. Provide a summary of the analyses that supported the introduction of GNF2 fuel.

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<sup>1</sup> A proprietary (i.e., non-publicly available) version of the PUSAR is contained in Attachment 6 to the application dated September 28, 2012. A non-proprietary (i.e., publicly available) version of the PUSAR is contained in Attachment 4 to the application dated September 28, 2012.

Enclosure

- d. Sections 2.8.2.4.6 and 2.8.2.4.7 of the PUSAR indicate that there will not be mixed cores following implementation of the proposed EPU. However, Section 2.8.1 seems to indicate there may be different "fuel types through EPU implementation." Specify whether the uprated PBAPS cores will have mixed cores. Also provide a description of the methods that will be used to assure the uprate fuel limits are satisfied

#### **SNPB-RAI-2**

It is stated in Section 1.1 of the PUSAR that "fuel-dependent topics" follow ELTR1<sup>2</sup>. In Section 1.1.1 of the PUSAR it is stated that for generic assessments that are "GNF2 fuel design dependent" the assessments contained in ELTR1 and ELTR2<sup>3</sup> are applicable. Please clarify what is meant by the two statements.

#### **SNPB-RAI-3**

Section 1.2.3 of the PUSAR states "Reactor Core and Fuel Performance: Specific analyses required for EPU have been performed for a representative fuel cycle with the reactor core operating at EPU conditions." Please provide a summary of these analyses and denote which will be performed on a cycle-specific basis.

#### **SNPB-RAI-4**

Section 2.8.1 of the PUSAR states that "[t]he EPU evaluations assume a reference equilibrium core of GNF2 fuel. GNF2 fuel is resident in the PBAPS core. The fuel design limits are established for all new fuel product line designs as a part of the fuel introduction and reload analyses." The PUSAR then makes a statement concerning fuel product line designs and further states that "[a]t the CLTP [current licensed thermal power] as well as at the EPU RTP [rated thermal power] conditions, all fuel design limits will be met through fuel bundle and core design combined with plant operational strategies. However, revised loading patterns, larger batch sizes and potentially new fuel designs may be used to provide additional operating flexibility and maintain fuel cycle length."

Provide clarification to the statement above as to what is meant by "revised loading patterns, larger batch sizes and potentially new fuel designs may be used to provide additional operating flexibility and maintain fuel cycle length."

#### **SNPB-RAI-5**

Section 2.8.2 of the PUSAR briefly describes the core design process. This section states, in part, that:

The additional energy requirements for power uprate are met by an increase in bundle enrichment, an increase in the reload fuel batch size, and/or changes in

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<sup>2</sup> ELTR1 refers to General Electric (GE) Licensing Topical Report (LTR) NEDC-32424P-A, "Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate."

<sup>3</sup> ELTR2 refers to GE LTR NEDC-32523P-A, "Generic Evaluations of General Electric Boiling Water Reactor Extended Power Uprate."

fuel loading pattern to maintain the desired plant operating cycle length. The power distribution in the core is changed to achieve increased core power, while limiting the minimum critical power ratio (MCPR), maximum linear heat generation rate (MLHGR), and maximum average planar linear heat generation rate (MAPLHGR) in any individual fuel bundle to be within limits as defined in the COLR [core operating limits report].

General Design Criterion (GDC) 10 of Appendix A to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 requires the reactor core and associated coolant, control and protection systems to be designed with appropriate margin to assure that specified acceptable fuel design limits (SAFDLs) are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences (AOOs). Please provide further details on the planned: (a) increase in bundle enrichment; (b) increase in the reload fuel batch size; (c) changes in fuel loading patterns; and (d) changes in power distribution. Specifically, provide information to demonstrate that the planned changes will continue to meet the requirements in GDC-10.

#### **SNPB-RAI-6**

Describe the analysis procedure used to ensure that the shutdown margin is within the Technical Specification limit throughout the transition and equilibrium cycles of EPU operation. Specifically, describe how the eigenvalue biases and uncertainties are determined and accounted for during the transition cycles.

#### **SNPB-RAI-7**

Provide a summary of fuel cycle calculations, for a representative equilibrium core design, that demonstrates the feasibility of EPU RTP operation while maintaining fuel design limits.

#### **SNPB-RAI-8**

Provide a summary of analyses performed to determine the thermal limits listed below. The summary should include the methodology, computer codes used, and the results obtained from the analyses. Also, please provide the impact of increased bundle power on the following operating parameters.

- a. Safety Limit MCPR
- b. Operating Limit MCPR
- c. APLHGR Limit
- d. Linear Heat Generation Rate (LHGR)

#### **SNPB-RAI-9**

Please describe how the required hot excess reactivity and shutdown margin are maintained in the uprated PBAPS unit cores.

#### **SNPB-RAI-10**

GDC 10 requires that the reactor core and associated coolant, control and protection systems to be designed with appropriate margin to assure that SAFDLs are not exceeded during any

condition of normal operation, including the effects of AOOs. A critical heat flux correlation specific to a type of fuel is developed, for use in the core design and safety analyses, to accurately predict the expected critical power performance. The PUSAR for PBAPS has not included a description of how SAFDLs are maintained during normal operations and during any AOOs. Please provide responses to the following requests:

- a. Provide details of the specific GEXL correlation that will be used to determine the thermal margin for the uprated operating cycles for the PBAPS unit cores. Your response should include how the correlation is used to determine the change in critical power ratio (CPR) during postulated transients and in the determination of an acceptable MCPR limit.
- b. Please provide a discussion of the impact of increased bundle power due to EPU on the CPR performance and the R-factor.

#### **SNPB-RAI-11**

Section 2.8.2.4.4 of the PUSAR provides the licensee's response to Limitation and Condition 9.24 of GEH Licensing Topical Report (LTR) NEDC-33173-P-A, "Applicability of GE Methods to Expanded Operating Domains," for EPU applications. The licensee has provided Figures 2.8-1 through 2.8-6 in which the PBAPS data are plotted with the available EPU experience base as required by the Limitation and Condition 9.24. However, there is no qualitative description of how the PBAPS data at various cycle exposure statepoints provide insight in to the core conditions of the plant-specific application against the EPU experience base. Therefore, please provide how the parameters for PBAPS behave with respect to the EPU experience base as indicated in these plots.

In addition, the licensee has provided Figures 2.8-7 through 2.8-18 showing bundle power, bundle operating MCPR, and LHGR for the beginning of cycle (BOC), middle of cycle (MOC) and end of cycle (EOC). The purpose of this limitation/condition is for evaluation of minimum margins to specific limits at various applicable exposures. As such, please discuss the availability of margins for the specified parameters in the figures mentioned above.

#### **SNPB-RAI-12**

Depending on the response to SNPB RAI-1 for the types of fuel (GE14 and/or GNF2), will any of the PBAPS unit cores qualify as a mixed core? If any of the cores is a mixed core, provide a detailed description as to how Limitation and Conditions 9.21 and 9.22 of NEDC-33173P-A are satisfied.

#### **SNPB-RAI-13**

In a draft RAI on May 14, 2013, the NRC staff indicated that it plans to run confirmatory calculations of the GNF2 fuel rod design using the FRAPCON-3.4<sup>4</sup> computer code to support the PBAPS EPU review. In this RAI, the staff requested that the licensee provide the input parameters needed to perform the calculations. In a conference call on May 23, 2013, the

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<sup>4</sup> NUREG/CR-7022, Volume 1, "FRAPCON-3.4: A Computer Code for the Calculation of Steady-State Thermal-Mechanical Behavior of Oxide Fuel Rods for High Burnup," and Volume 2, "FRAPCON-3.4: Integral Assessment," Office of Nuclear Regulatory Research, US NRC, March 2011.

licensee stated that this issue relates to the GNF2 fuel design, which has been previously reviewed generically by the NRC staff (i.e., issue is not specific to the PBAPS EPU review). In an e-mail on May 29, 2013, the licensee referenced the NRC staff's safety evaluation (SE) for Amendment 32 to Topical Report NEDE-24011-P, "General Electric Standard Application for Reactor Fuel (GESTAR II)" dated July 30, 2009 (ADAMS Accession No. ML091680754). Specifically, the licensee's e-mail stated that the NRC staff had confirmed the GNF2 fuel rod designs using the FRAPCON computer code as discussed in the staff's SE for Amendment 32 to GESTAR II. As such, the licensee questioned the need for the staff to perform confirmatory calculations using the FRAPCON code to support the PBAPS EPU.

The NRC staff has reviewed this issue further based on the above interactions with the licensee. The NRC staff has determined that, provided that PBAPS maintains the same thermal-mechanical operating limit (TMOL) and thermal overpower (TOP)/mechanical overpower (MOP) limits, that were part of the GNF2/PRIME implementation, then no further FRAPCON confirmatory calculations by the staff are necessary. Please provide detailed justification for not providing the FRAPCON input parameters by explaining that plant operation, at EPU conditions, will maintain the same TMOL and TOP/MOP limits that were part of the original GNF2/PRIME implementation.

M. Pacilio

- 2 -

If you have any questions, please contact me at (301) 415-1420.

Sincerely,

/ra/

Richard B. Ennis, Senior Project Manager  
Plant Licensing Branch I-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-277 and 50-278

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